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# Quality of Western Canadian Malting Barley 1990

Canada

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# 1990

**D.E. LaBerge**
Head, Malting Barley Applied Research

**K.H. Tipples**
Director

**Crop Bulletin No. 186**

**Grain Research Laboratory**
**Canadian Grain Commission**
**1404-303 Main Street**
**Winnipeg, Manitoba**
**R3C 3G8**

**Figure 1. Major Barley Producing Area in Canada**

## Introduction

This is the second edition of a new series of crop bulletins to describe the quality of malting barley grown in the three prairie provinces of Western Canada. Barley is also the major grain crop grown in Western Canada as a coarse grain for livestock feed, and another crop bulletin entitled *Quality of Western Canadian Feed Barley 1990* is available upon request. Figure 1 shows in general the major barley producing areas in Canada.

Barley growers in the Canadian Prairies have demonstrated a preference for growing malting barley varieties. During the past 46 crop years, malting barley was grown on an average of 70% of the total barley area (Fig.2). Malting barley is a dual purpose barley; if production cannot be sold at a premium for malting and brewing, then it is utilized as livestock feed. Registered feed barley varieties are not suitable for malting and brewing and, as a result, can only be used for livestock feed.

During recent years, there have been significant changes in the production patterns of six-rowed and two-rowed malting barley varieties in the prairie provinces (Fig. 3). Traditionally, six-rowed malting barley varieties were dominant, reflecting the preference of Canadian brewers to utilize six-rowed malt. However, with the release of improved two-rowed barley selections, particularly Harrington, two-rowed selections are now predominate in the malting barley areas of the western region of the prairie provinces. In turn, domestic brewers now use more than 50% of two-rowed malt in their malt blends and this trend is likely to continue in the years to come.

Two new two-rowed malting barley cultivars have been given interim registrations for market development studies. Stein (TR 479) is adapted to the western prairie region where Harrington predominates while Manley (TR 490), a sister line of Stein, has the disease resistance characteristics required to extend the two-rowed malting barley growing area into eastern Saskatchewan and Manitoba. These selections will not be grown commercially for at least another year but have exciting promise for further improvements of the malting quality of Canadian two-rowed malting barley.

**Figure 2. Trends in Malting and Feed Barley Production in the Prairie Provinces Since 1945**

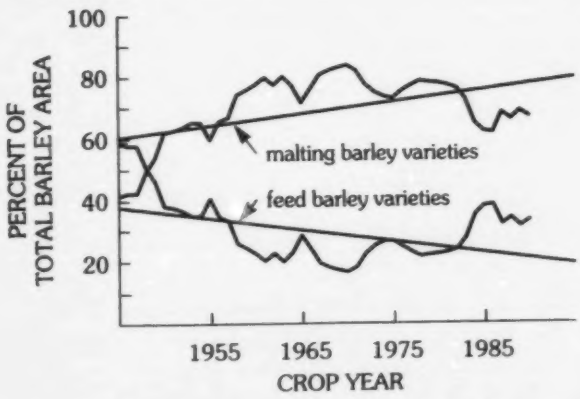
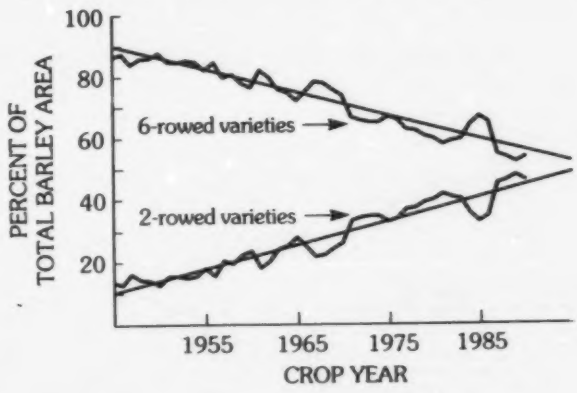



**Figure 3. Trends in Total Barley Production in the Prairie Provinces Since 1945**



## Review of Growing and Harvesting Conditions

Due to rather cool and wet conditions, barley seeding got off to a slow start in 1990. By the end of May, 20% of the crop remained to be sown with delays most pronounced in eastern Saskatchewan and parts of western Alberta, notably the Claresholm-Cardston and Red Deer regions. Barley was still being sown near the end of June in those areas of western Alberta that were inundated with rain between late May and mid-June.

Growing conditions during June and July were mostly favourable, though a lack of rain in the first half of the growing season did cause some stress and loss of yield potential in crops in northern parts of the grain belt in Saskatchewan and adjoining areas of Alberta. These moisture deficits were largely erased in July, however, and conditions for filling the crop were predominantly good.

August was relatively warm and dry, especially in the eastern prairies, and the barley harvest proceeded rapidly in Manitoba with 50% of the crop combined by the end of the month. Further west, crops matured more slowly with only 15% of the barley in Saskatchewan and Alberta harvested by the end of August. However, exceptionally warm, dry September weather provided ideal conditions for ripening and harvesting. As a result, concern over vulnerability to frost due to late seeding and a relatively cool growing season proved unfounded. In general, very few harvest problems were encountered, as reflected in the good quality of this year's crop.

On average over the prairie region, the barley yield was the second highest on record. Yield results were consistently good in the major barley-growing areas, reflecting the generally adequate moisture supply through the growing season and the lack of any sustained heat stress.

## Production Estimates

Estimates of total barley production in the prairie provinces during 1990 and 1989 are presented in Table 1. Total barley production in 1990 is estimated to be 11 788 000 tonnes which is an increase of 12.9% compared with 1989. This increase was due entirely to increased yields in 1990 as the prairie provinces recovered somewhat from drought conditions that were prevalent during the previous two crop years. Seeded area was estimated to be down from the 1989 level by 81 000 hectares.

The distribution of malting barley varieties in the prairie provinces in 1990 is shown in Figure 4. The 2-rowed malting barley Harrington predominates in all crop districts of Alberta and Saskatchewan. Six-rowed barley, Bonanza and Argyle, predominates in Manitoba.

For comparative purposes, the distributions of barley varieties for 1989 and 1988 are presented in Figures 5 and 6 - illustrating the dominance of Harrington barley in Alberta and Saskatchewan for three consecutive crop years.

**1. Estimate of Total Barley Production in the Prairie Provinces[1] Comparison of 1990 and 1989 Data**

| | Seeded Area | | Yield | | Production | |
|---|---|---|---|---|---|---|
| | 1989 | 1990 | 1989 | 1990 | 1989 | 1990 |
| | (thousand hectares) | | (tonnes/hectare) | | (thousand tonnes) | |
| Manitoba | 647 | 627 | 2.39 | 3.21 | 1 546 | 2 014 |
| Saskatchewan | 1 497 | 1 416 | 2.01 | 2.71 | 3 005 | 3 832 |
| Alberta | 2 064 | 2 064 | 2.76 | 3.02 | 5 704 | 6 227 |
| **Prairie Provinces** | **4 208** | **4 107** | **2.44** | **2.94** | **10 255** | **12 073** |

[1] November Estimate of Production, Statistics Canada, *Field Crop Reporting Series*, No. 8, November 30, 1990

## Sampling and General Crop Quality

This year's harvest survey is based on 7,874 samples of malting barley selected by domestic malting companies for potential purchase. Barley selectors for these companies composited samples by variety (or varieties) and by province (or provinces) and forwarded these composite samples to the Grain Research Laboratory on a regular basis from the beginning of harvest to the end of September 1990, at which time the survey was discontinued. Details as to numbers and source of samples are given in Table 2. Each sample selected for purchase by maltsters may result in delivery of one railway carlot of approximately 80 tonnes of barley.

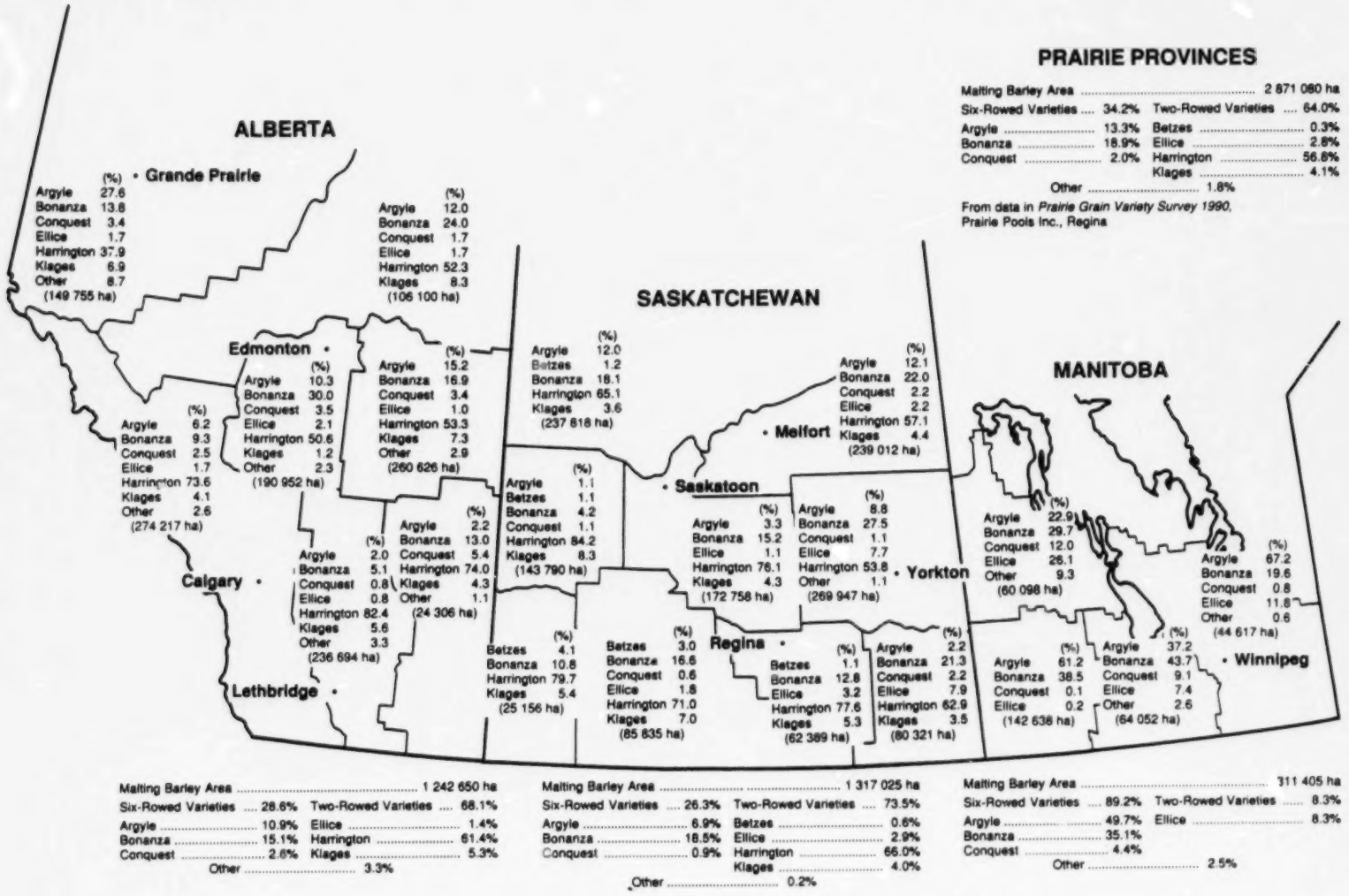
Growing and harvesting conditions in 1990 were generally satisfactory in most regions of the prairie provinces. The major exception was in central Alberta where seeding was delayed by heavy rain; and harvesting of the late-seeded crop was again delayed by rain and some frost damage occurred in this region.

The majority of two-rowed samples in this survey were from Saskatchewan (Table 2) where growing conditions were generally favourable. There are adequate amounts of good two-rowed and six-rowed spring barley to meet normal domestic requirements and normal export commitments for barley malt which together average about one million tonnes annually. There is sufficient good quality malting barley available for export if there is an export demand. Otherwise, there will likely be a carry-over of good quality malting barley into the 1991 crop year.

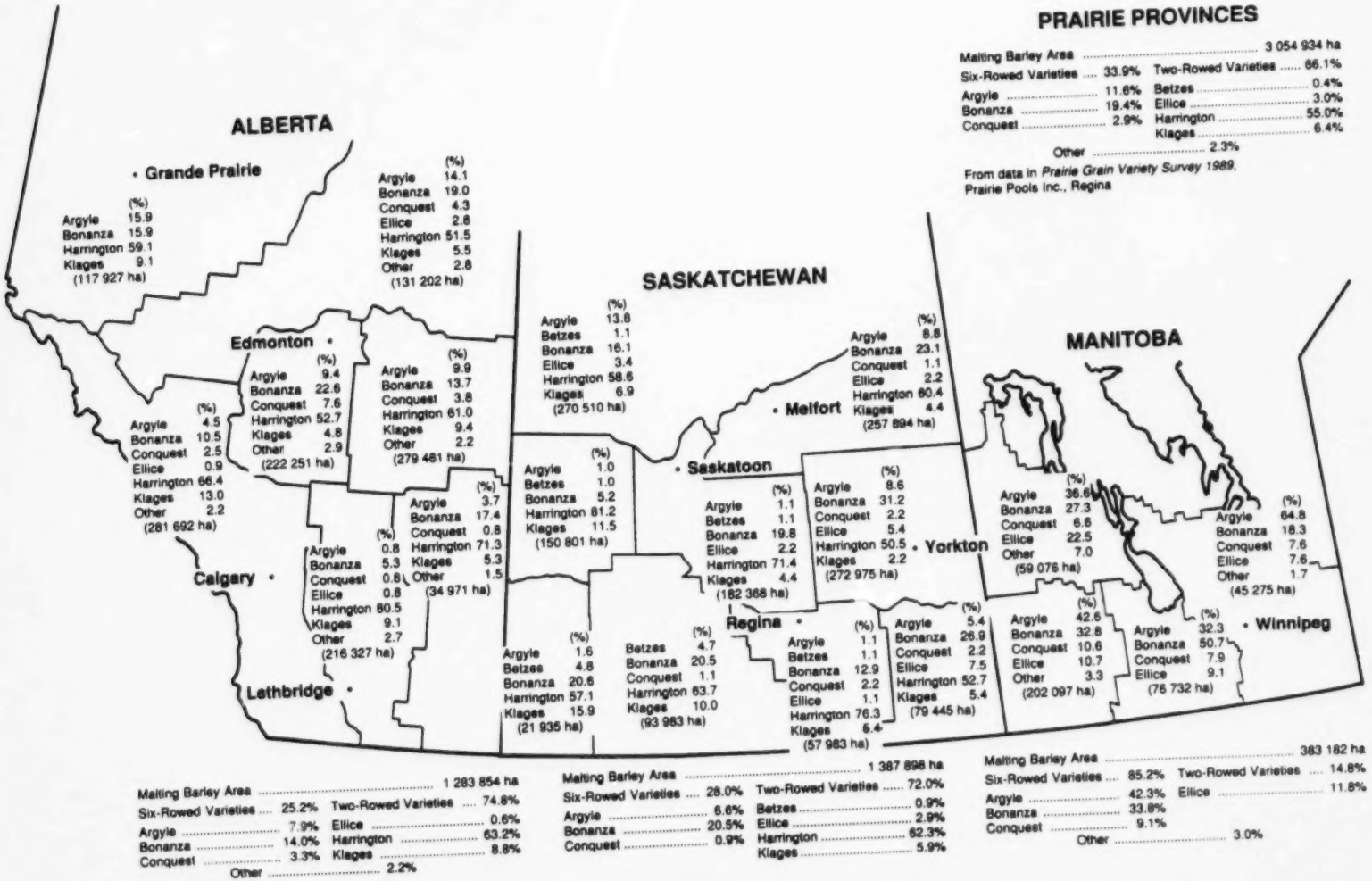
**2. Origin and Distribution of 1990 Harvest Survey Samples (for each varietal composite)**

| Variety | Provincial Origin | | | | |
|---|---|---|---|---|---|
| | Alberta | Saskatchewan | Manitoba | Saskatchewan & Manitoba | Prairie Provinces |
| Bonanza | 259 | - | - | 450 | 709 |
| Bonanza/Argyle | - | 112 | - | - | 112 |
| Argyle | 100 | - | - | 375 | 475 |
| **Total 6-rowed** | **359** | **112** | **-** | **825** | **1 296** |
| Harrington | 2 090 | 4 373 | 90 | - | 6 553 |
| Ellice | - | - | - | 25 | 25 |
| **Total 2-rowed** | **2 090** | **4 373** | **90** | **25** | **6 578** |
| **Total Selections** | **2 449** | **4 485** | **90** | **850** | **7 874** |

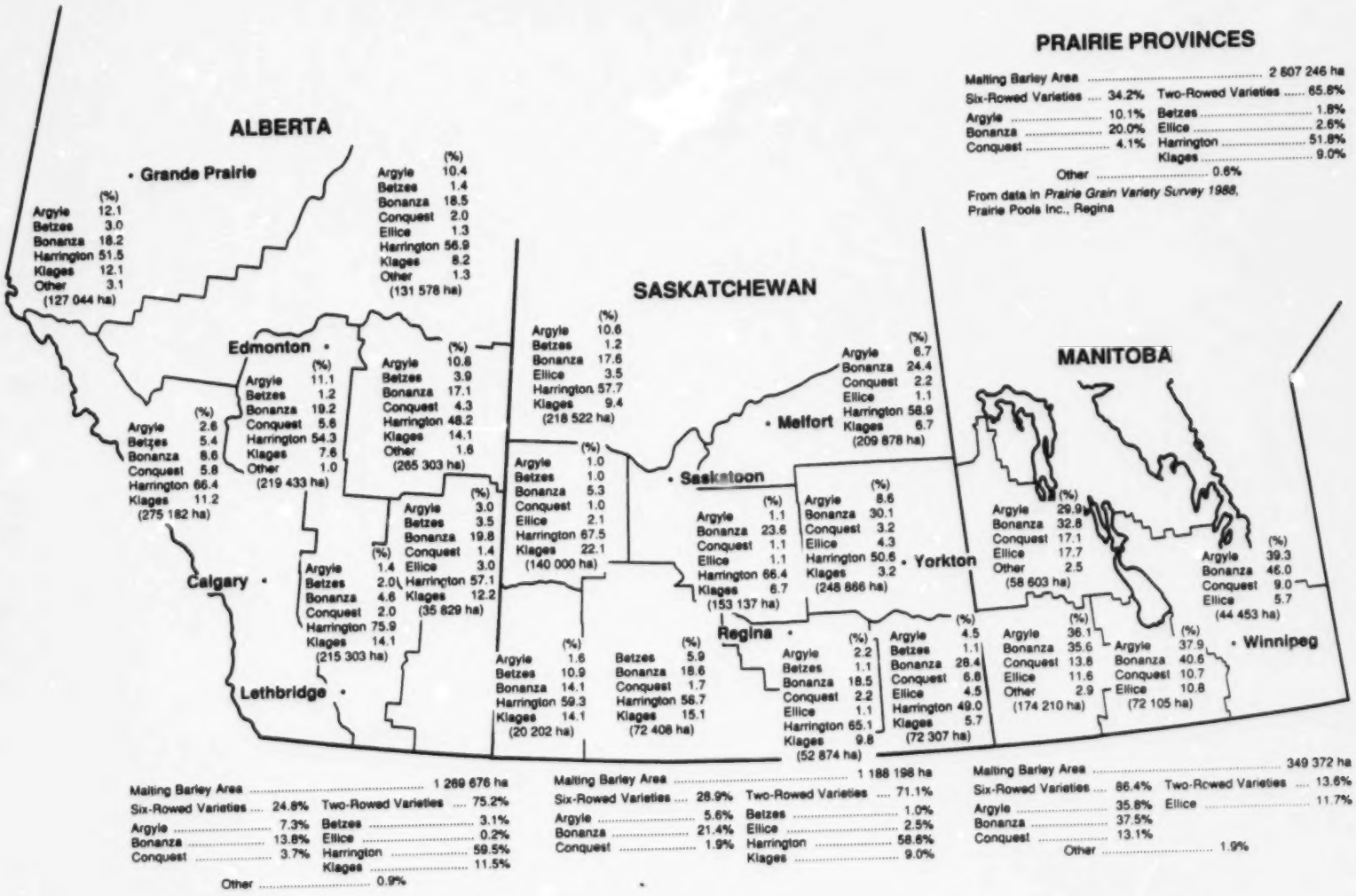
# Figure 4. Distribution of Malting Barley Varieties by Crop District for 1990 (as percent of total malting barley seeded areas)


PRAIRIE PROVINCES
Malting Barley Area ..... 2 871 080 ha
Six-Rowed Varieties .... 34.2% Two-Rowed Varieties .... 64.0%
Argyle ..... 13.3% Betzes ..... 0.3%
Bonanza ..... 18.9% Ellice ..... 2.8%
Conquest ..... 2.0% Harrington ..... 56.8%
Klages ..... 4.1%
Other ..... 1.8%
From data in Prairie Grain Variety Survey 1990, Prairie Pools Inc., Regina
ALBERTA
SASKATCHEWAN
MANITOBA
Grande Prairie
Edmonton
Calgary
Lethbridge
Melfort
Saskatoon
Regina
Yorkton
Winnipeg
(%) Argyle 27.6 Bonanza 13.8 Conquest 3.4 Ellice 1.7 Harrington 37.9 Klages 6.9 Other 8.7 (149 755 ha)
(%) Argyle 12.0 Bonanza 24.0 Conquest 1.7 Ellice 1.7 Harrington 52.3 Klages 8.3 (106 100 ha)
(%) Argyle 6.2 Bonanza 9.3 Conquest 2.5 Ellice 1.7 Harrington 73.6 Klages 4.1 Other 2.6 (274 217 ha)
(%) Argyle 10.3 Bonanza 30.0 Conquest 3.5 Ellice 2.1 Harrington 50.6 Klages 1.2 Other 2.3 (190 952 ha)
(%) Argyle 15.2 Bonanza 16.9 Conquest 3.4 Ellice 1.0 Harrington 53.3 Klages 7.3 Other 2.9 (260 626 ha)
(%) Argyle 2.0 Bonanza 5.1 Conquest 0.8 Ellice 0.8 Harrington 82.4 Klages 5.6 Other 3.3 (236 694 ha)
(%) Argyle 2.2 Bonanza 13.0 Conquest 5.4 Harrington 74.0 Klages 4.3 Other 1.1 (24 306 ha)
(%) Argyle 12.0 Betzes 1.2 Bonanza 18.1 Harrington 65.1 Klages 3.6 (237 818 ha)
(%) Argyle 1.1 Betzes 1.1 Bonanza 4.2 Conquest 1.1 Harrington 84.2 Klages 8.3 (143 790 ha)
(%) Argyle 12.1 Bonanza 22.0 Conquest 2.2 Ellice 2.2 Harrington 57.1 Klages 4.4 (239 012 ha)
(%) Argyle 3.3 Bonanza 15.2 Ellice 1.1 Harrington 76.1 Klages 4.3 (172 758 ha)
(%) Argyle 8.8 Bonanza 27.5 Conquest 1.1 Ellice 7.7 Harrington 53.8 Other 1.1 (269 947 ha)
(%) Argyle 22.9 Bonanza 29.7 Conquest 12.0 Ellice 26.1 Other 9.3 (60 098 ha)
(%) Argyle 67.2 Bonanza 19.6 Conquest 0.8 Ellice 11.8 Other 0.6 (44 617 ha)
(%) Betzes 4.1 Bonanza 10.8 Harrington 79.7 Klages 5.4 (25 156 ha)
(%) Betzes 3.0 Bonanza 16.6 Conquest 0.6 Ellice 1.8 Harrington 71.0 Klages 7.0 (85 635 ha)
(%) Betzes 1.1 Bonanza 12.8 Ellice 3.2 Harrington 77.6 Klages 5.3 (62 389 ha)
(%) Argyle 2.2 Bonanza 21.3 Conquest 2.2 Ellice 7.9 Harrington 62.9 Klages 3.5 (80 321 ha)
(%) Argyle 61.2 Bonanza 38.5 Conquest 0.1 Ellice 0.2 (142 638 ha)
(%) Argyle 37.2 Bonanza 43.7 Conquest 9.1 Ellice 7.4 Other 2.6 (64 052 ha)
Malting Barley Area ..... 1 242 650 ha
Six-Rowed Varieties .... 28.6% Two-Rowed Varieties .... 68.1%
Argyle ..... 10.9% Ellice ..... 1.4%
Bonanza ..... 15.1% Harrington ..... 61.4%
Conquest ..... 2.6% Klages ..... 5.3%
Other ..... 3.3%
Malting Barley Area ..... 1 317 025 ha
Six-Rowed Varieties .... 26.3% Two-Rowed Varieties .... 73.5%
Argyle ..... 6.9% Betzes ..... 0.6%
Bonanza ..... 18.5% Ellice ..... 2.9%
Conquest ..... 0.9% Harrington ..... 66.0%
Klages ..... 4.0%
Other ..... 0.2%
Malting Barley Area ..... 311 405 ha
Six-Rowed Varieties .... 89.2% Two-Rowed Varieties .... 8.3%
Argyle ..... 49.7% Ellice ..... 8.3%
Bonanza ..... 35.1%
Conquest ..... 4.4%
Other ..... 2.5%

# Figure 5. Distribution of Malting Barley Varieties by Crop District for 1989 (as percent of total malting barley seeded areas)



# Figure 6. Distribution of Malting Barley Varieties by Crop District for 1988 (as percent of total malting barley seeded areas)


PRAIRIE PROVINCES
Malting Barley Area ..... 2 607 246 ha
Six-Rowed Varieties .... 34.2% Two-Rowed Varieties ..... 65.8%
Argyle ..... 10.1% Betzes ..... 1.8%
Bonanza ..... 20.0% Ellice ..... 2.6%
Conquest ..... 4.1% Harrington ..... 51.8%
Klages ..... 9.0%
Other ..... 0.6%
From data in Prairie Grain Variety Survey 1988, Prairie Pools Inc., Regina
ALBERTA
SASKATCHEWAN
MANITOBA
Grande Prairie
Edmonton
Calgary
Lethbridge
Melfort
Saskatoon
Regina
Yorkton
Winnipeg
(%) Argyle 12.1 Betzes 3.0 Bonanza 18.2 Harrington 51.5 Klages 12.1 Other 3.1 (127 044 ha)
(%) Argyle 10.4 Betzes 1.4 Bonanza 18.5 Conquest 2.0 Ellice 1.3 Harrington 56.9 Klages 8.2 Other 1.3 (131 578 ha)
(%) Argyle 2.6 Betzes 5.4 Bonanza 8.6 Conquest 5.8 Harrington 66.4 Klages 11.2 (275 182 ha)
(%) Argyle 11.1 Betzes 1.2 Bonanza 19.2 Conquest 5.6 Harrington 54.3 Klages 7.6 Other 1.0 (219 433 ha)
(%) Argyle 10.8 Betzes 3.9 Bonanza 17.1 Conquest 4.3 Harrington 48.2 Klages 14.1 Other 1.6 (265 303 ha)
(%) Argyle 1.4 Betzes 2.0 Bonanza 4.6 Conquest 2.0 Harrington 75.9 Klages 14.1 (215 303 ha)
(%) Argyle 3.0 Betzes 3.5 Bonanza 19.8 Conquest 1.4 Ellice 3.0 Harrington 57.1 Klages 12.2 (35 829 ha)
(%) Argyle 10.6 Betzes 1.2 Bonanza 17.6 Ellice 3.5 Harrington 57.7 Klages 9.4 (218 522 ha)
(%) Argyle 1.0 Betzes 1.0 Bonanza 5.3 Conquest 1.0 Ellice 2.1 Harrington 67.5 Klages 22.1 (140 000 ha)
(%) Argyle 1.6 Betzes 10.9 Bonanza 14.1 Harrington 59.3 Klages 14.1 (20 202 ha)
(%) Betzes 5.9 Bonanza 18.6 Conquest 1.7 Harrington 56.7 Klages 15.1 (72 408 ha)
(%) Argyle 6.7 Bonanza 24.4 Conquest 2.2 Ellice 1.1 Harrington 58.9 Klages 6.7 (209 678 ha)
(%) Argyle 1.1 Bonanza 23.6 Conquest 1.1 Ellice 1.1 Harrington 66.4 Klages 6.7 (153 137 ha)
(%) Argyle 8.6 Bonanza 30.1 Conquest 3.2 Ellice 4.3 Harrington 50.6 Klages 3.2 (248 866 ha)
(%) Argyle 2.2 Betzes 1.1 Bonanza 18.5 Conquest 2.2 Ellice 1.1 Harrington 65.1 Klages 9.8 (52 874 ha)
(%) Argyle 4.5 Betzes 1.1 Bonanza 28.4 Conquest 6.8 Ellice 4.5 Harrington 49.0 Klages 5.7 (72 307 ha)
(%) Argyle 29.9 Bonanza 32.8 Conquest 17.1 Ellice 17.7 Other 2.5 (58 603 ha)
(%) Argyle 36.1 Bonanza 35.6 Conquest 13.8 Ellice 11.6 Other 2.9 (174 210 ha)
(%) Argyle 37.9 Bonanza 40.6 Conquest 10.7 Ellice 10.8 (72 105 ha)
(%) Argyle 39.3 Bonanza 46.0 Conquest 9.0 Ellice 5.7 (44 453 ha)
Malting Barley Area ..... 1 269 676 ha
Six-Rowed Varieties .... 24.8% Two-Rowed Varieties .... 75.2%
Argyle ..... 7.3% Betzes ..... 3.1%
Bonanza ..... 13.8% Ellice ..... 0.2%
Conquest ..... 3.7% Harrington ..... 59.5%
Klages ..... 11.5%
Other ..... 0.9%
Malting Barley Area ..... 1 188 198 ha
Six-Rowed Varieties .... 28.9% Two-Rowed Varieties .... 71.1%
Argyle ..... 5.6% Betzes ..... 1.0%
Bonanza ..... 21.4% Ellice ..... 2.5%
Conquest ..... 1.9% Harrington ..... 58.6%
Klages ..... 9.0%
Malting Barley Area ..... 349 372 ha
Six-Rowed Varieties .... 86.4% Two-Rowed Varieties .... 13.6%
Argyle ..... 35.8% Ellice ..... 11.7%
Bonanza ..... 37.5%
Conquest ..... 13.1%
Other ..... 1.9%

## Malting Quality Data

### Harrington

Quality data for this two-rowed selection are given in Table 3. Kernel weight and plumpness are satisfactory, and the average protein content of 11.8% is very good.

In the 1989 quality survey of malting barley, almost all of the barley samples were over-modified, as indicated by low fine-grind/coarse-grind extract differences and by high ratios of soluble to total protein in wort. To overcome these problems, germination time for the 1990 composite samples was reduced from 5 days to 4 day to more closely simulate commercial malting. Even with these changes, fine-grind extract yields for Harrington malt are improved from last year, and malt modification is satisfactory. Amylolytic activities of Harrington malts are lower in 1990 than in 1989.

### Klages and Ellice

None of the barley selectors submitted samples of Klages barley this year. This is probably an indication that brewers no longer want Klages as a proportion of their malt blends.

Ellice is a two-rowed cultivar adapted to growing conditions in eastern Saskatchewan and Manitoba where Harrington is not recommended to be grown. One composite sample of Ellice, comprised of 25 selected samples, modified very well and had high soluble protein and a high ratio of soluble to total protein (Table 4) - a characteristic of this selection. Low residual beta-glucan in a malt extract is another characteristic of Ellice barley.

### Bonanza

Table 5 provides quality data for composite samples of Bonanza barley, a six-rowed selection. The composite samples had good germination characteristics and had lower protein content than is usual for Canadian 6-rowed barley. As a result, diastatic power of malt prepared from Bonanza is somewhat lower than usual for this variety. Other malt quality characteristics are satisfactory.

### Argyle and Bonanza/Argyle

Argyle and Bonanza six-rowed barleys have very similar malting characteristics and can be blended with one another prior to malting. Some of the composite samples from Alberta and Saskatchewan exhibited some water-sensitivity, but germination energy is satisfactory (Table 6). The malt quality characteristics of Argyle and Bonanza/Argyle blends are very similar to Bonanza (Table 5) except that Argyle tends to have somewhat higher amylolytic activity.

**3. Quality Data for 1990 Harvest Survey Composite Samples of Malting Barley**

| Variety | Harrington | | | |
|---|---|---|---|---|
| Origin of Selected Samples | Alberta | Saskatchewan | Manitoba | Prairie Provinces |
| No. of Selections | 2 090 | 4 373 | 90 | 6 553 |
| **BARLEY** | | | | |
| Physical Characteristics | | | | |
| 1000 Kernel Weight, g | 40.8 | 40.3 | 40.9 | 40.7 |
| Heavy Grade, % | 89.9 | 91.1 | 89.7 | 90.2 |
| Intermediate Grade, % | 8.5 | 7.6 | 8.6 | 8.2 |
| Thin Grade, % | 1.4 | 1.3 | 1.7 | 1.5 |
| Chemical Analysis | | | | |
| Moisture Content, % | 10.8 | 12.5 | 12.7 | 12.0 |
| Protein Content, % | 11.5 | 11.8 | 12.2 | 11.8 |
| Germination Characteristics | | | | |
| Germination Energy, % | 98 | 100 | 100 | 99 |
| Water Sensitivity, % | 4 | 2 | 0 | 2 |
| **MALT** | | | | |
| Physical Characteristics | | | | |
| Malt Yield, % | 94.1 | 94.5 | 93.7 | 94.1 |
| Roots, % | 2.8 | 2.5 | 2.5 | 2.6 |
| Chemical Analysis | | | | |
| Moisture Content, % | 4.5 | 4.6 | 4.6 | 4.6 |
| **WORT** | | | | |
| Fine Grind Extract, % | 79.5 | 79.9 | 80.6 | 80.0 |
| Coarse Grind Extract, % | 77.4 | 77.7 | 78.8 | 78.0 |
| F/C Difference, % | 2.1 | 2.2 | 1.8 | 2.0 |
| Beta-glucan Content, ppm | 310 | 299 | 132 | 247 |
| Viscosity, cps | 1.60 | 1.67 | 1.59 | 1.62 |
| Soluble Protein, % | 4.86 | 4.72 | 5.38 | 4.99 |
| Ratio S/T, % | 42.8 | 42.5 | 47.2 | 44.2 |
| Diastatic Power, °L | 112 | 112 | 130 | 118 |
| Alpha-amylase, DU | 54.9 | 51.5 | 54.8 | 53.8 |

**4. Quality Data for 1990 Harvest Survey Composite Samples of Malting Barley**

| Variety | Ellice |
|---|---|
| Origin of Selected Samples | Saskatchewan/Manitoba |
| No. of Selections | 25 |
| **BARLEY** | |
| Physical Characteristics | |
| 1000 Kernel Weight, g | 39.3 |
| Heavy Grade, % | 90.0 |
| Intermediate Grade, % | 8.5 |
| Thin Grade, % | 1.5 |
| Chemical Analysis | |
| Moisture Content, % | 12.6 |
| Protein Content, % | 10.7 |
| Germination Characteristics | |
| Germination Energy, % | 100 |
| Water Sensitivity, % | 2 |
| **MALT** | |
| Physical Characteristics | |
| Malt Yield, % | 92.8 |
| Roots, % | 2.9 |
| Chemical Analysis | |
| Moisture Content, % | 4.5 |
| **WORT** | |
| Fine Grind Extract, % | 80.1 |
| Coarse Grind Extract, % | 79.5 |
| F/C Difference, % | 0.6 |
| Beta-glucan Content, ppm | 16 |
| Viscosity, cps | 1.55 |
| Soluble Protein, % | 5.22 |
| Ratio S/T, % | 51.1 |
| Diastatic Power, °L | 104 |
| Alpha-amylase, DU | 44.6 |

**5. Quality Data for 1990 Harvest Survey Composite Samples of Malting Barley**

| Variety | Bonanza | | |
|---|---|---|---|
| Origin of Selected Samples | Alberta | Saskatchewan & Manitoba | Prairie Provinces |
| No. of Selections | 259 | 450 | 709 |
| **BARLEY** | | | |
| Physical Characteristics | | | |
| 1000 Kernel Weight, g | 35.3 | 34.1 | 34.7 |
| Heavy Grade, % | 80.9 | 82.0 | 81.5 |
| Intermediate Grade, % | 16.0 | 15.1 | 15.5 |
| Thin Grade, % | 3.0 | 3.0 | 3.0 |
| Chemical Analysis | | | |
| Moisture Content, % | 9.8 | 12.4 | 11.1 |
| Protein Content, % | 11.6 | 11.9 | 11.7 |
| Germination Characteristics | | | |
| Germination Energy, % | 100 | 99 | 100 |
| Water Sensitivity, % | 1 | 3 | 2 |
| **MALT** | | | |
| Physical Characteristics | | | |
| Malt Yield, % | 94.1 | 94.4 | 94.2 |
| Roots, % | 3.0 | 3.4 | 3.2 |
| Chemical Analysis | | | |
| Moisture Content, % | 4.5 | 4.7 | 4.6 |
| **WORT** | | | |
| Fine Grind Extract, % | 78.1 | 79.3 | 78.7 |
| Coarse Grind Extract, % | 76.2 | 76.6 | 76.4 |
| F/C Difference, % | 1.9 | 2.5 | 2.2 |
| Beta-glucan Content, ppm | 294 | 253 | 273 |
| Viscosity, cps | 1.62 | 1.80 | 1.71 |
| Soluble Protein, % | 4.50 | 4.48 | 4.49 |
| Ratio S/T, % | 39.2 | 39.8 | 39.5 |
| Diastatic Power, °L | 92 | 111 | 101 |
| Alpha-amylase, DU | 40.9 | 38.6 | 39.7 |

**6. Quality Data for 1990 Harvest Survey Composite Samples of Malting Barley**

| Variety | Argyle | | | Bonanza/ Argyle |
|---|---|---|---|---|
| Origin of Selected Samples | Alberta | Saskatchewan & Manitoba | Prairie Provinces | Saskatchewan |
| No. of Selections | 100 | 375 | 475 | 112 |
| **BARLEY** | | | | |
| Physical Characteristics | | | | |
| 1000 Kernel Weight, g | 33.7 | 34.5 | 34.1 | 34.2 |
| Heavy Grade, % | 82.1 | 82.4 | 82.2 | 93.0 |
| Intermediate Grade, % | 15.4 | 14.1 | 14.7 | 6.3 |
| Thin Grade, % | 2.6 | 3.5 | 3.0 | 0.7 |
| Chemical Analysis | | | | |
| Moisture Content, % | 9.3 | 11.7 | 10.5 | 12.8 |
| Protein Content, % | 11.8 | 11.5 | 11.7 | 11.9 |
| Germination Characteristics | | | | |
| Germination Energy, % | 100 | 100 | 100 | 99 |
| Water Sensitivity, % | 10 | 1 | 5 | 9 |
| **MALT** | | | | |
| Physical Characteristics | | | | |
| Malt Yield, % | 94.1 | 94.8 | 94.4 | 94.1, |
| Roots, % | 3.1 | 3.0 | 3.1 | 3.0 |
| Chemical Analysis | | | | |
| Moisture Content, % | 4.3 | 4.6 | 4.4 | 4.7 |
| **WORT** | | | | |
| Fine Grind Extract, % | 79.1 | 78.9 | 79.0 | 78.3 |
| Coarse Grind Extract, % | 76.5 | 76.4 | 76.4 | 75.4 |
| F/C Difference, % | 2.6 | 2.5 | 2.5 | 2.9 |
| Beta-glucan Content, ppm | 382 | 263 | 322 | 339 |
| Viscosity, cps | 1.63 | 1.45 | 1.54 | 1.84 |
| Soluble Protein, % | 4.61 | 4.65 | 4.63 | 4.51 |
| Ratio S/T, % | 39.6 | 41.7 | 40.6 | 38.9 |
| Diastatic Power, °L | 99 | 135 | 117 | 111 |
| Alpha-amylase, DU | 45.8 | 52.2 | 49.0 | 37.4 |

# Methods

Notes on the methods used at the Grain Research Laboratory are given below. Unless otherwise specified, analytical results for barley and malt are reported on a dry weight basis. The ASBC methods cited are those of the American Society of Brewing Chemists, Seventh Edition, 1976.

**Dockage and Assortment.** All samples are passed through a Carter Dockage Tester equipped with a No. 6 riddle to remove foreign material and with 6/64" and 5/64" screens to assort the barley. Heavy Grade barley is the material retained on a 6/64" (2.38 mm) screen. Intermediate Grade is barley retained on a 5/64" (1.98 mm) screen, and Thin Grade is the barley that passes through the 5/64" screen.

**Weight per Thousand Kernels.** A small sample of dockage-free, Heavy Grade barley is hand-picked to remove any residual foreign material and broken kernels. The number of kernels in a 20 g subsample of this cleaned material is then counted.

**Moisture Content of Barley** is determined using a Tag-Heppenstall moisture meter and a Grain Research Laboratory moisture conversion table.

**Moisture Content of Malt (ASBC)** is determined on a ground sample at 104°C for 3 h in a convection oven.

**Protein Content (N x 6.25)** is determined on Heavy Grade barley by the Kjeldahl method as modified by Williams, *Journal of the Science of Food and Agriculture* 24:343, 1973.

**Germination Energy** is determined by placing 100 kernels of Heavy Grade barley on Whatman #2 filter paper in a 9.0 cm petri dish and adding 4.0 mL of deionized water. Samples are kept in the dark at room temperature. Germinated kernels are counted and removed after 72 h, and a final germination count is determined after a further 48 h.

**Water Sensitivity** is determined exactly as described for germination energy, except that 8.0 mL of deionized water is added to each petri dish. Water sensitivity is defined as the difference between the number of kernels germinated with 4.0 mL of water and 8.0 mL of water, multiplied by 100.

**Malting Conditions.** Malts are prepared using an Automatic Phoenix Micromalting System designed to handle twenty-four 500 g samples of barley per run. Samples are steeped at 13°C for 48 h - alternating 8 h of wet steep and 4 h of air rest during the steeping regime. Samples are germinated for 96 h at 15°C and 100% R.H. Kilning is carried out over 48 h as follows: 6 h from 30°C to 48°C, 16 h at 48°C, 8 h from 48°C to 66°C, 10 h at 66°C, 2 h from 66°C to 85°C and 6 h at 85°C.

**Malt Mills (ASBC).** Fine-grind malt is prepared with a Miag-Seck laboratory cone mill set to fine grind (0.2 mm gap). Coarse-grind malt is prepared with the same mill set to coarse grind (1.0 mm gap).

**Fine-Grind and Coarse-Grind Extracts (ASBC)** are prepared using a Brewing Research Foundation (BRF) mash bath and the Congress mashing procedure from 45°C to 70°C. Specific gravities are determined at 20°C with an Anton Paar DMA 55 digital density meter (LaBerge, *Journal of the American Society of Brewing Chemists* 37:105, 1979).

**Wort-Soluble Protein (ASBC)** is determined by the Kjeldahl method as modified by Williams, *Journal of the Science of Food and Agriculture* 24:343, 1973.

**Diastatic Power (ASBC)** is determined using the ferricyanide assay for reducing sugars.

**Alpha-Amylase Activity** is determined using beta-limit dextrin, prepared from waxy maize starch, as substrate (Briggs, *Journal of the Institute of Brewing* 67:427, 1961). Alpha-amylase activity determined by this method is converted to Dextrinizing Units (DU) using regression equations relating this method to the official ASBC procedure.

**Beta-Glucan Content of Malt Extract** is determined by flow injection analysis using Calcoflour staining of soluble, high molecular weight beta-glucan (Jorgensen, *Carlsberg Research Communications* 53:277, 1988). Congress extract is diluted 1:1 with deionized water prior to analysis.

## Acknowledgements

The Grain Research Laboratory acknowledges the cooperation of domestic malt companies for providing composite samples of varietal selections of malting barley. Special thanks are extended to Mr. Jack Tye, Canada Malting Co., Ltd., Winnipeg, Mr. Bob Sutton, Canada Malting Co., Ltd., Calgary, Mr. Al Morris, Dominion Malting Limited, Winnipeg and Mr. Jack Foster and Mr. Mustafa Rehmanjii, Prairie Malting Ltd., Biggar. The Weather and Crop Surveillance Section of the Canadian Wheat Board is acknowledged for providing the synopsis of weather and growing conditions affecting the quality of malting barley. The assistance of the Brewing and Malting Barley Research Institute, Winnipeg, for providing the cover photograph is also gratefully acknowledged. Special thanks are also extended to the following staff of the Grain Research Laboratory: M. Stethem, A. Mitchelson, J. Bethune and D. Langrell.